GROWTH RATES AND FOOD CONSUMPTION OF HAND-RAISED MERLINS

Lynn W. Oliphant and Stacey V. Tessaro

Abstract - Growth curves were constructed for two male and two female Merlins that were hand raised. Growth rates and maximum size of the hand-reared birds appear to be substantially lower than wild birds, possibly due to a lack of moisture in the diet. Daily food consumption was measured and used to estimate food requirements for a Merlin family group. For a pair with 4 young, a total of 800 sparrow-sized birds are required for a 120-day breeding season.

Each year hundreds of raptors are hand-raised by falconers or by the various institutional breeding projects. This presents a unique opportunity to gather data on growth rates, food consumption and general development. Such information is useful for accurate aging of nestlings, comparisons of growth rates under different conditions (differing prey densities, brood size, etc.), determination of prey requirements of a nesting pair of birds, and optimizing conditions of hand-rearing. This study describes observations on the development of 2 pairs of the Merlin (*Falco columbarius richardsonii*) that were hand-reared.

Methods

Pair #1 was taken from a nest on 15 June 1975 as small downies of unknown age. Pair #2 was hatched in captivity (Roll-X incubator, 36.7°C) in 1979 from a clutch of eggs taken immediately after clutch completion. Both pairs were initially maintained in simple brooder boxes heated by light bulbs. Temperature was regulated on the basis of behaviour of the young falcons, being gradually reduced to room temperature.

Diets and feeding regimes for the 2 pairs were slightly different. Pair #1 was fed a mixture of laboratory mice (head, gastrointestinal tract and skin removed) and day-old chicks (feet, beak and skin removed) in a ratio of 3 mice to 1 chick. Food was ground in a meat grinder and frozen in meal-size packages. The birds were fed as much as they would eat 5 times/d for the first 6 d, 4 times/d for the next 10 d and 2-3 times/d thereafter. For each feeding the meat was thawed, brought rapidly to room temp and fed by forceps until the Merlins could eat from a small saucer. In addition to their regular fare, they were given a freshly killed House Sparrow (*Passer domesticus*) that was minced by hand and fed fresh on 4 occasions.

Pair #2 was fed only freshly-killed Coturnix (*Coturnix* sp.). For the first 3 d after hatching, these Merlins were fed small amounts of diced breast muscle, heart, liver and small crushed bone fragments. Afterwards they were fed freshly ground whole quail (beak, gastrointestinal tract and skin removed). This pair was fed 4 times/d for the first 15 d, 3 times/d from the 15th to 22nd d and 2 times/d afterwards. They were fed in the same manner as pair #1 and allowed to eat as much as they wanted.

Both pair were weighed to the nearest 1/100 g on a Sartorius electrical balance before and after feeding to determine the weight of food consumed. Weights used to document daily weight gain were morning weights prior to the first feeding of the day. Little casting material was given and weights of the few castings were ignored.

Pair #1 was placed in a hack box with 2 other Merlins taken from a nest just prior to fledging which were a few days further advanced than the hand-reared pair. All 4 fledged together although the hand-reared female, being the youngest, was not capable of sustained flight until 5 d later and was picked up for a final weighing 2 d after fledging.

Pair #2 was tame hacked for a week after training to a lure allowing them to be brought in every night. After the hack, this pair was kept in outdoor mews and both birds flown twice daily for the next month, primarily at large flocks of House Sparrows (*Passer domesticus*) as part of a crop depredation experiment. During this time they were fed 2 times/d on either Coturnix Quail or wild birds they had caught, receiving about half a crop in the morning and a full crop each evening (1 1/2-2 sparrows/d).

Growth curves for both pairs were generated using a computer program to fit the data to a smooth curve. The growth function used for this curve is the differential equation of Richards (1959).

Results

Both pairs consisted of 1 male and 1 female. Pair #2 hatched within an hr of each other on 14 June. Weights at hatching were 13.0 g and 13.7 g. The hatching dates for the 1975 pair were estimated to be 6 June (male) and 9 June (female) using physical development and weights as compared to pair #2 and wild nestlings of known age. Growth curves for both pairs are shown in Figs. 1 and 2 with day 0 being hatching day. The growth curves exhibit a typical sigmoid shape reaching peak weights between day 23 and 27 with a slight drop in weight afterwards. The inflection, or point of highest growth rate, was reached at day 14 or 15.

Pair #1 was considerably larger than pair #2 and attained maximum weights of 265 g (female) and 203 g (male) as compared to 226 g (female) and 174 g (male). Maximum weights were 10-30 g higher than weights at fledging. Pair #2 was flown at 207±5 g (female) and 146±5 g (male). Their weights were remarkably consistent from day to day.

Food consumption (Figs. 3 and 4) showed an almost straight line increase from hatching to day 12-14 (Fig. 4). Consumption then levelled off and was maintained at maximum levels with some fluctuation for the remainder of the rapid growth phase, decreasing when body weight approached

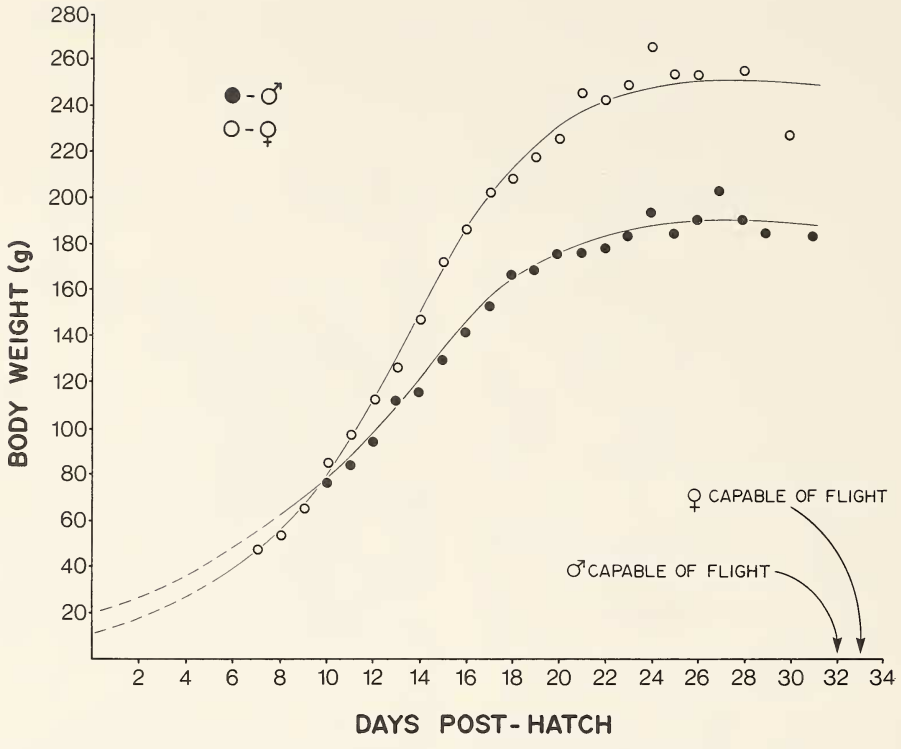

Figure 1. Growth curve for Pair #1.

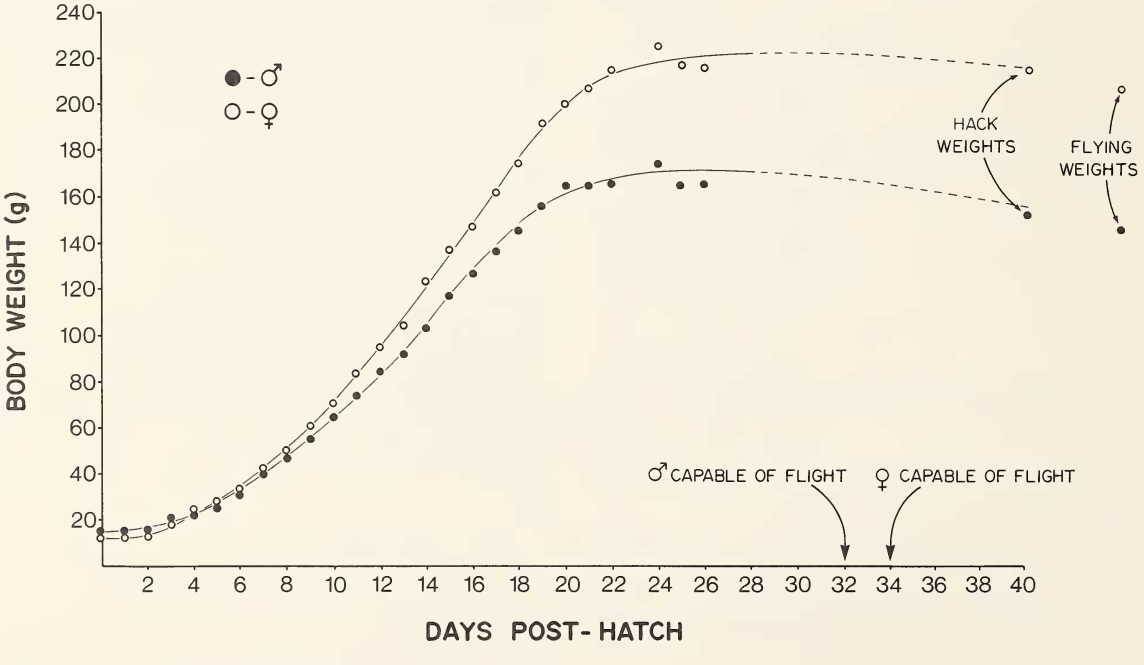

Figure 2. Growth curve for Pair #2.

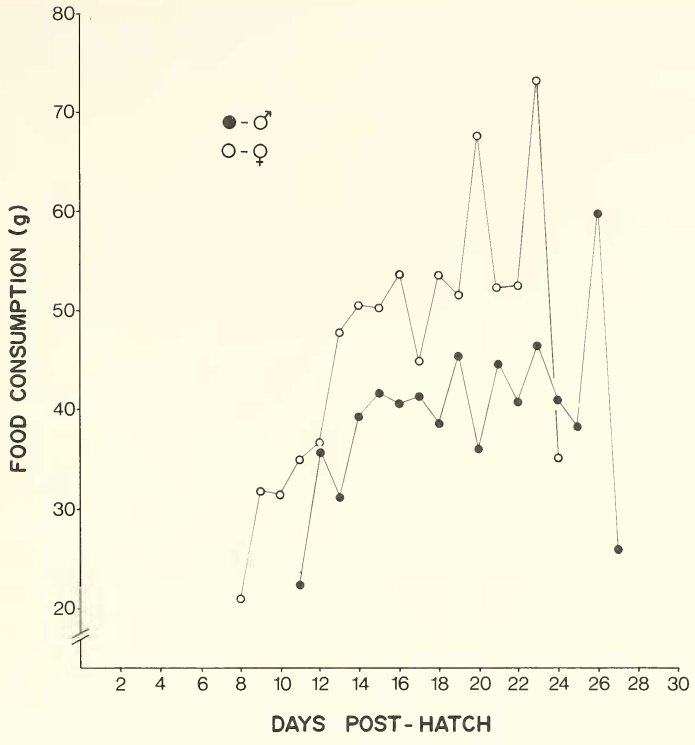

Figure 3. Food consumption - Pair #1.

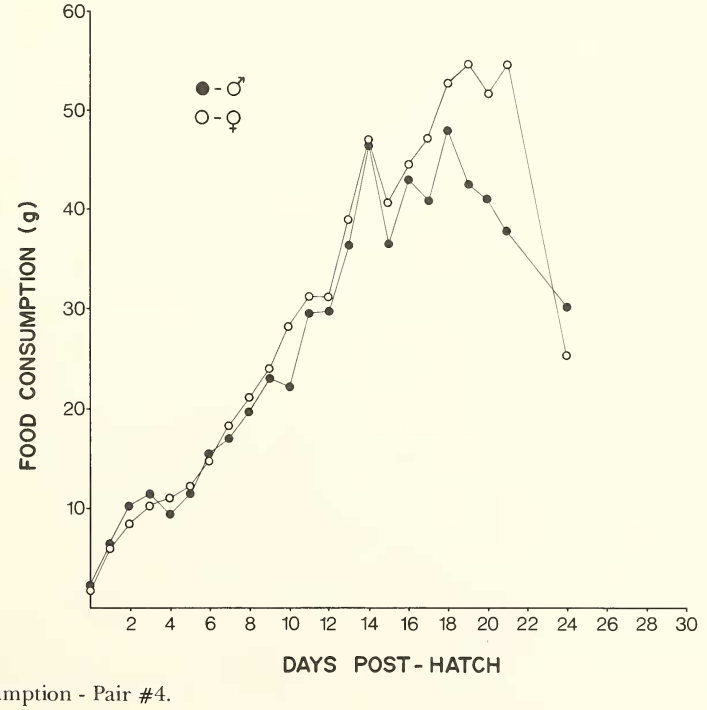

Figure 4. Food consumption - Pair #4.

the maximum. The average amount of food consumed during this period was very similar for the males (40.0 g/d). The female from pair #1 consumed 52.4 g/d as compared to 46.1 g/d for the other female. Food consumption decreased by day 23-27 to about 30 g/d for both males and females.

General observations on the development of the 4 birds are presented in Table 1. There was a slight variation in the appearance of various behaviour patterns with males developing ahead of females. Post-hatching development is broken down somewhat arbitrarily into 5 major periods: day 0-3 (newborn); 4-11 (small downy); 12-21 (large downy); 22-28 (brancher); and 29-independence (fledgling).

DISCUSSION

Basic growth parameters for Merlins have been reported (Ricklefs 1968a, b) but are incorrect. The original data from which these growth parameters were derived are for the Prairie Falcon (*Falco mexicanus*) (Fowler 1931) and the reported weights

Table 1. Post-hatching Development

	DAY	OBSERVATIONS
Newborn	1	Hatch; eyes closed, down wet.
	1	Down dry.
	3	Eyes open.
Small Downy	4-8	Enter period of rapid growth; Become aware of surroundings; Second down coat develops.
	9-11	Sheathed contour feathers appear; Sitting erect on tarsi; Wing flapping begins.
Large Downy	12-14	Primaries break sheaths; First casting.
	15-17	Rectrices break sheaths; Egg tooth is lost; Standing upright.
	18-21	Cheek and flank feathers develop; Flight feathers developing rapidly; Grappling and holding food with feet; Increased wing flapping; Leveling off of food consumption and weight gain.
Brancher	22-28	Maximum weight attained; Rapid replacement of down by contour feathers (down visible only on head by 28 days); Short jumping "flights."
Fledgling	29-34	Fledging; become capable of sustained flight.
	35-40	First long flights and development of flying abilities; Interest shown in potential prey (first pursuit of bird at 36 days, 1979 (male). First bath.
	40-50	Hunting begins; first kills on flying insects; first bird kill [Day 42, 1979 (female)]. Some down still remains on head. Completion of feather growth.
	50-60	Become independent; disperse.

were incorrectly converted from ounces to grams and mistakenly reported as *Falco columbarius*.

The significance of the lower weights at full growth for pair #2 as compared to pair #1 is difficult to assess due to small sample size and minor differences in feeding regimes, handling, etc. Data collected on weights of wild nestlings of known age suggest, however, that even pair #1 was smaller and exhibited slower growth rates than most wild nestlings. Weights of 12 wild females between 20 and 28 d old all exceeded 250 g (limit of scales used) and weights of 5 wild, 11 d old nestlings (unsexed) weighed an average of 129.6 g (103-160 g) as compared to 80 g for pair #2 and 90 g for pair #1. It should be noted that our estimate of the hatching dates of pair #1 may be as much as 2 d too early based upon the observed weights of wild nestlings. The difference in growth rates cannot be attributed solely to differences in food quality between our hand-reared birds and wild birds. Weights of 3 captive bred Merlins (2 females, 1 male) raised by their parents but fed only Coturnix quail averaged 120 g at day 11.

In 1979 we had the opportunity to directly compare our hand-reared pair (#2) with a wild nestling (male) which had hatched on the same date. The wild Merlin had fledged prematurely from a nest site. The birds were 27 d old at the time of comparison but on the basis of feather development and flight capabilities the wild bird appeared to be 4-5 d more advanced than the hand-reared pair.

There has been recent evidence to suggest that growth rates and final body size may be less in falcons reared by people as compared to those cared for by falcons (The Peregrine Fund; MacDonald Raptor Research Centre, pers. comm.) Jim Weaver (The Peregrine Fund) suggested that this difference might be due to fluids added to the food from the nasal glands of the adult falcon during feeding. Addition of physiological saline to the food appears to counteract this slower growth which is especially apparent during the early stages of development (Oliphant, unpub. obs.). Olendorff (1972) has also noted the potential problem of dehydration in hand-reared buteos and, more recently, Wallace at the University of Wisconsin (Dobbs et al. 1979) showed that diets containing less than 55% moisture slowed growth or even halted growth in young of the Turkey Vulture (*Cathartes aura*). The moisture content of 5 wk old quail given by Dobbs et al. (1979) is very low (45%) in comparison to other whole animal food. It appears that until further studies are done, it would be prudent to add water or physiological saline to ground quail being fed to hand-raised raptors.

There was a noticeable difference in the tarsus, cere and orbit color of our hand-reared birds as compared to wild nestlings. Our birds had blue or blue-green skin as compared to the bright yellow color of wild nestlings of advanced age. This is undoubtedly due to the relative lack of carotenoid pigments in the diet of our hand-reared birds.

Development of vocalizations was retarded in our hand-reared birds. When pair #1 was placed in the hack box with the 2 late taken wild young, they only made food begging cries typical of nestlings. The 2 late taken wild young had already developed a typical adult call with a rapid stacatto delivery. Even a wk after fledging this difference was still apparent. The response of these birds to a wild adult male Merlin that appeared in the hack area was also very different. The late taken birds begged for food and chased the adult male but the hand-reared birds ignored him.

Based upon our values, the total food requirements for 1 Merlin from hatching to fledging are about 1,000 g. This can be expected to vary slightly depending on sex and size of the particular nestling and nutritive value of the food consumed.

Sparrow-sized birds are the principal food of Merlins (Oliphant and McTaggert 1977; Hodson 1978). Average weights of freshly killed sparrows in Saskatoon were 28.6 g in summer (n=15) and 35.6 g in winter (n=10). The weight of a plucked carcass with head and tarsus removed averaged about 80% of fresh wt. This gives a value of about 25 g of useful food per average sparrow kill. The total food requirements per Merlin during the nestling period is therefore about 40 sparrows. Based upon the food consumption of pair #2 after fledging, an additional 38 sparrows would be required from the time of fledging to independence at day 55. Assuming similar food requirements for a pair of breeding adults over an entire 120-d breeding season results in an additional 210 sparrows required per adult. The total calculated prey requirements for a breeding pair and 4 young would therefore be 732 sparrows.

Observations at wild nests in the city of Saskatoon indicate that these calculations are close, but probably on the low side. We recorded a total of 5 sparrows killed (3-4 expected) during incubation by

watching at 1 Merlin nest site from dawn to dusk. A similar watch at a nest site with 5 one wk old young recorded 10 sparrow kills (8-9 expected). This slightly higher than calculated kill rate could be due partially to the occasional loss of some kills during plucking or food transfers (whole carcasses were occasionally found at nest sites) and loss of cached food (Oliphant and Thompson 1976) either stolen by other birds or simply forgotten. The actual number of House Sparrow-sized birds killed by a breeding pair with 4 young is probably close to 800 for a 120-d breeding period. This is somewhat lower than that estimated by Lawrence (1949) which would have amounted to a total of 1,140 for a brood of 4 young over a 120-d breeding season.

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Department of Veterinary Anatomy, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, S7N OWO CANADA. Address of second author: Animal Pathology Laboratory, Agriculture Canada, 116 Veterinary Road, Saskatoon, Saskatchewan, S7N OWO CANADA.